College of Engineering
LAMAR UNIVERSITY

Power Pedalers: Folding Electric Bicycle

Team Objectives

❖ **Problem:**
- Millions of bicycles are stolen each year.
- Bicycle theft discourages usage and ownership.

❖ **Solution:**
- Develop a **foldable** electric bicycle that is convenient and portable.
- Enhanced portability allows users to store bicycles safely indoors or in secure locations, reducing the risk of theft.

❖ **Additional Features:**
- Incorporate electric propulsion to improve ease of use.
- Make bicycles a more practical alternative to fossil fuel vehicles, especially for longer commutes.

❖ **Design Compliance:**
- Adhere to ASME e-HPVC competition rules.
- Follow Texas state laws regarding electric bicycles.
- **Note: The project will not be entered into the competition but will still meet its standards.**

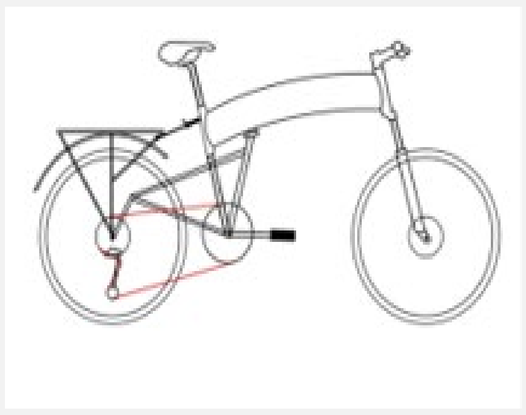
E-HPVC Competition Guidelines

❖ **Safety:**
- Must be able to stop at a speed of 25 km/h over 6 m.
- Must have an electrical shutoff switch.
- Maximum system voltage of 50V.
- Must be able to stop under electric propulsion.

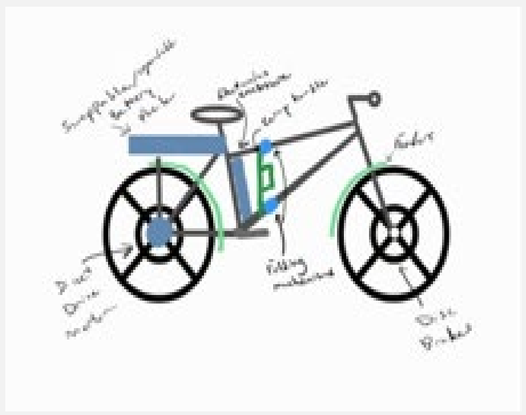
❖ **Performance/Requirements:**
- Must demonstrate stability while travelling 30 m in a straight line at a speed of 5 to 8 km/h.
- Must have a turn radius of 8 m at most
- Motor with a maximum capacity of 500W.

Frame Design Process

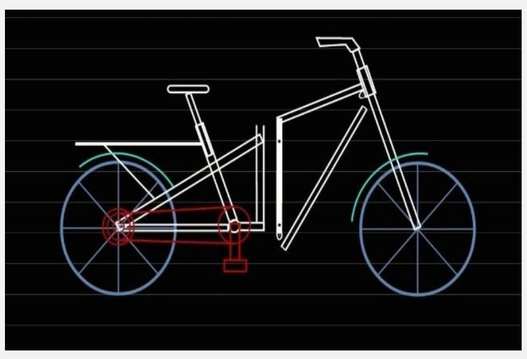
- Typical e-HPVC vehicles are three-wheeled electric cycles.
- Riders typically sit low to the ground, level with wheels and pedals.
- Our project prioritizes portability and practical everyday use.
- We chose to design a two-wheeled electric bicycle with folding capability.



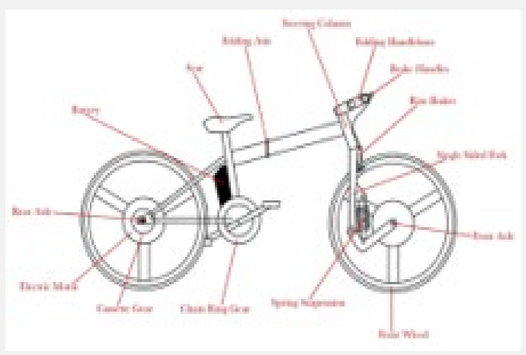
Initial Concept Design 1



Initial Concept Design 2



Initial Concept Design 3



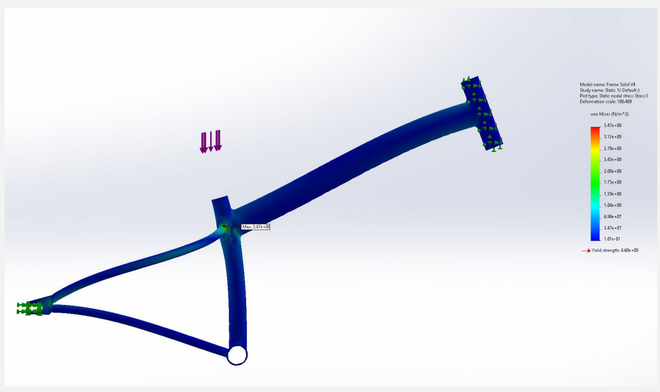
Initial Concept Design 4

❖ **Chosen Concept**
- Bicycle with folding handlebars.
- Single thick pipe connecting seat and steering column for convenient folding.
- Single-sided suspension to reduce folded size.
- Initial battery placement beneath the seat.
- Focus on low overall weight and small folded footprint for easier handling.

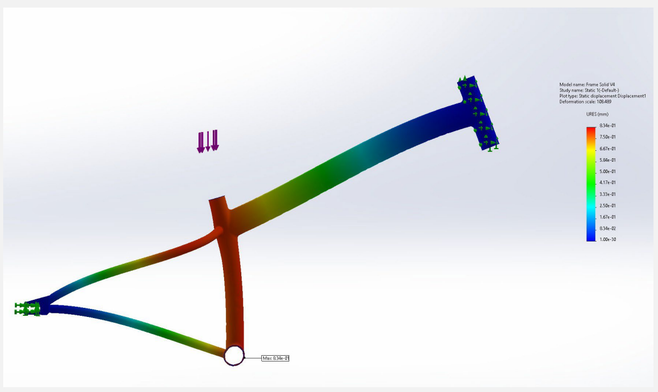
❖ **Design Changes for Practicality and Cost Reduction:**
- Switched to dual cylindrical single-sided suspension for better reliability, reduced weight, and improved stability.
- Moved battery from beneath the seat to a rack above the rear tire:
  - Addressed space limitations.
  - Improved weight distribution by placing the battery above the rear axle.

Frame Finite Element Analysis

- **Finite Element Analysis (FEA):**
- Conducted using SolidWorks.
- Frame material: 4130 steel with a yield strength of 460 MPa.
- **Simulation Parameters:**
- Applied a 450-pound load:
  - Based on a safety factor of 2.
  - Designed load capacity of 225 pounds.
- **Simulation Details:**
- Load applied at the seat position.
- Stress concentrations observed
  - Highest stress occurred where seat stay tube meets with the seat tube.
  - Max stress increased to 347 MPa at that junction.
- Maximum displacement occurred along the seat tube:
  - Displacement of 0.83 mm.



Seat Load Stresses



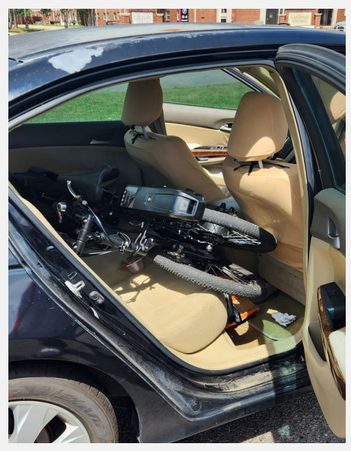
Seat Load Displacement

Final Product

Final Design Render

- Full design and rendering completed in SolidWorks before construction.
- Battery repositioned to a rack above the rear tire for better stability.
- Dual cylindrical suspension system added for increased stability and practicality.

	eHPVC Guidelines	Test Results
Max Speed (Electric)	N/A	20 km/hr
Braking Dist. at 25 km/hr	< 6 m	4.8 m
Turn Radius	< 8 m	3.5 m
Stability for 30 m at 5-8 km/hr	Yes	Yes
Range (Electric)	N/A	30 km (19 mi)



Bicycle Folded

Bicycle Unfolded

❖ **Build Challenges & Final Improvements**
- Main issue was aligning components properly.
- Frequent cutting and rewelding needed due to unforeseen design complications.
- Minor changes made throughout to improve foldability and ergonomics.
- Bicycle uses electric propulsion (not pedal assist), controlled by a throttle on the handlebar.

❖ **Conclusion**

Successfully designed and assembled a working foldable e-bike that meets the standards required by the ASME eHPVC guidelines.

Students & Faculty Advisors

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Sponsorships

Lamar University